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ABSTRACT

Abstracts of papers presented at the 1982 Annual Meeting of the Society for College Science Teachers (SCST) are listed alphabetically by first author in this two-part program. The first set of 28 abstracts represents a wide range of topics and issues in college science teaching, including among others, solar energy, scientific/technical writing, student characteristics (cognitive style, intellectual development, and others), college science curriculum (biology, chemistry, microbiology, environmental studies), teaching methods, and facilities. Fifty-four abstracts of papers presented during an SCST-sponsored symposium on federally funded projects in college science teaching are listed in the second part of the program. Various topics and issues in college science curriculum and instruction are addressed including among others, setting up a computing center, computer literacy, computer graphics, computer assisted instruction, microcomputers in college science education, coastal-environmental studies, pre-freshmen engineering program, laboratory experiences in particular and science in general for the non-science student, microcomputer software in science, laboratory in sensory physiology and perception, and an instructional management and student evaluation tool for programs in individualized instruction. (JN)

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Program and Abstracts
Volume 2 1982

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SE 037 861

PROGRAM

SOCIETY FOR COLLEGE SCIENCE TEACHERS

NSTA CONVENTION - APRIL 1-5, 1982, CHICAGO

All SCST Sessions Are Held At *The Conrad Hilton Hotel*
Abstracts are listed alphabetically by first author beginning on page 1.

[NOTE: Program and Abstracts for SCST Symposium on federally funded projects in college science teaching are on pages 17-52.]

FRIDAY, APRIL 2, 1982
8:00-9:00 AM

Private Dining Room Number 3
Society for College Science Teachers Annual Business Meeting

11:00-12:00 AM

Parlor 419

1. Scientific and Technical Writing: How to Improve Your Skills.
   Presider: Peter Fenner, Office of the Chancellor, Purdue University Calumet, Hammond, IN
   Presenters: Robert A. Day, Director, ISI Press; Walter Cory, Coordinator for School Sciences, Indiana University; John G. Truxal, Department of Technology and Society, SUNY, Stony Brook, NY

1:30-2:30 PM

Parlor 419

2. Biology Course Innovations.
   Presider: Orin G. Gelderloos, Professor of Biological Sciences, Natural Sciences Department, University of Michigan-Dearborn, Dearborn, MI

   BioConcepts, A Remedial Biology Course for College Freshmen.
   Presenter: Jeanette S. Mullins, Associate Professor, California State College, California, PA

   Implementation of a Cognitive Style Assessment Program in College Biology Courses.
   Presenter: Mary Jo Fourier, Department of Biological Sciences, Johnson County Community College, Overland Park, KS

   Clinical Applications Projects (CAPS) for Health Science Students in Introductory Microbiology.
   Presenter: Rebecca A. Halyard, Department of Biology, Clayton Junior College, Morrow, GA

4:00-5:00 PM

Parlor 419

3. Biology Course Innovations.
   Presider: Dr. Sterling L. Smith, Biology Department, Texas Woman's University, Denton, TX

Is There "Life" after Freshman Biology at a 2-Year College?
Presenter: John Berry, Wilbur Wright College, Chicago, Il

The Development and Use of a Self-Instructional Zoo and Museum Module as a Teaching Tool for Principles of Classification and Ecological Adaptation.
Presenter: Angela M. Sauro, Department of Biology, Mount Mary College, Milwaukee, WE

The Successess and Failures of Teaching a Blind Student Anatomy and Physiology at the Community College.
Presenter: Ed Krol, Biology Department, Henry Ford Community College, Dearborn, MI

5:00-6:00 PM

Williford Parlor B
SCST Coffee - Social Hour

SATURDAY, APRIL 3, 1982
8:00-9:00 AM

Parlor 419
4. Multi-Discipline Approaches To Instruction.
Presider: William C. Kyle, Jr., Science Education Center, The University of Iowa, Iowa City, IA

The Role of a Science Learning Center in the Teaching of Science.
Presenter: A.H. Benham, Department of Chemistry, The University of Texas at Arlington, Arlington, TX

Evaluation of a Mastery Program of Individualized Learning Modules.
Presenters: Linda K. Jones and Orin C. Gelderloos, Department of Natural Sciences, University of Michigan-Dearborn, Dearborn, MI

Putting Investigation Into The Science Laboratory.
Presenters: Leona C. Truchan, Wendell Kringen, Jean Schafer, and George Gurria, Natural Science and Technology Division, Alverno College, Milwaukee, WE

9:15-10:15 AM

Parlor 534
5. Science And The Environment
Presider: Theodore Lopushinsky, College of Natural Science, Department of Natural Science, East Lansing, MI

The Cost of Solar Energy.
Presenter: H. Kent Moore, Physics Department, James Madison University, Harrisonburg, VA

Integration of Environmental Science and Environmental Studies Programs.
Presenter: Orin G. Gelderloos, Natural Science Department, University of Michigan-Dearborn, Dearborn, MI

UNCLOS, Third World, and Transfer of Technology.
Presenter: Ralph Yalkovsky, Department of Geosciences, Physics and Interdisciplinary Sciences, State University College at Buffalo, Buffalo, NY

1:30-2:30 PM

Parlor 419

6. Science and Society.
Presider: Dr. Robert T. Ward, Department of Physics, University of Northern Iowa, Cedar Falls, IA

Societal and Educational Applications of Biological Concepts.
Presenters: William C. Kyle, Jr. and John E. Penick, Science Education Center, The University of Iowa, Iowa City, IA

What to do With the Non-Resident Term: Internship Program for College Students at the Brooklyn Botanic Garden.
Presenter: Paula J. Thompson, Brooklyn Botanic Garden, Brooklyn, NY

Freedom's Greatest Myth: Human Rights.
Presenter: Theodore Lopushinsky, Department of Natural Science, Michigan State University, East Lansing, MI

2:45-3:45 PM

Parlor 534

7. Learning Theories And Their Application In Science.
Presider: Ann H. Benham, Department of Chemistry, The University of Texas at Arlington, Arlington, TX

The Structure of Knowledge: Its Relation to Effective Teaching and Learning.
Presenter: Ralph W. Lewis, Department of Natural Science, Michigan State University, East Lansing, MI

Intellectual Development and Learning Science: The Implications of William Perry's Theory for Science Teachers.
Presenters: Michael P. Donovan and Robert D. Allen, Department of Biology, West Virginia University, Morgantown, WV

Using Laboratory Units Based on Gagne's Learning Hierachry in General College Chemistry.
Presenter: Kay M. Elsen, Department of Chemistry, Mount Mary College, Milwaukee, WE

4:00-5:00 PM

Parlor 534

8. The Teaching of Chemistry.
Presider: Charles R. Estee, Department of Chemistry, University of South Dakota, Vermillion, SD

Must College Science Teaching Be Such a Bore?
Presenter: Leonard C. Grotz, Chemistry Department, University of Wisconsin Waukesha County Center, Waukesha, WE

Can a General Chemistry Course Be All Things to All People?
Presenter: Sherry Anderson, Department of Natural Sciences, Castleton State College, Castelton, VT

Teaching Chemistry of Life Processes to a Heterogeneous Student Population.
Presenter: Jerry L. Sarquis, Department of Chemistry, Miami University, Middletown, OH

SUNDAY, APRIL 4, 1982
9:45-10:45 AM

Parlor 546

9. SCST Contributed Papers.
Presider: Leonard C. Grotz, Department of Chemistry, University of Wisconsin Waukesha County Center, Waukesha, WE

The Prefix-Suffix Road to Word Power.
Presenter: Barbara Batty, Department Science Head, Port Arthur Independent Schools, Port Arthur, TX

Art Forgeries and Science.
Presenter: William D. Wilk, Department of Chemistry, California State University, Dominquez Hills, Carson, CA

Difficulties with the Punnett Square Approach to Solving Mendelian Genetic Problems.
Presenter: Michael B. Moll, Department of Biology, West Virginia University, Morgantown, WV

11:00-NOON

Parlor 413

10. SCST Contributed Papers.
Presider: Walter Cory, Coordinator for School Sciences, Indiana University, Bloomington, ID

Physiological Correlates for Debilitating and Facilitating Testing Stimuli.
Presenter: William J. Kermis, Department of Science Education, The University of Texas at Dallas, Richardson, TX

Factors Affecting College Students' Performance on Proportional Reasoning Problems.
Presenter: Frances P. Collea, Department of Science Education, California State University, Fullerton, CA

Spatial Visualization Training Improves Performance in Organic Chemistry.
Presenter: Melinda V. Small, Department of Psychology, Bowdoin College, Brunswick, ME

Can a General Chemistry Course Be All Things to All People?

Sherry Anderson
Department of Natural Sciences
Castleton State College
Castelton, VT

Over the past two decades there has been a costly proliferation of introductory chemistry courses specially designed to meet the needs of a particular clientele as anyone familiar with the number of introductory chemistry texts published during this period can attest. Since we are now faced with an era of financial constraint in higher education, a unique year course in general chemistry developed at Castleton State College to service all students seems to be a viable and attractive alternative to multiple offerings at any one institution. The first semester of this course, which can be elected by non-science majors as a terminal course in chemistry, involves a structural and descriptive approach to the fields of chemistry starting with atomic structure and ending with a description of the more important biopolymers. Continuing into second semester, where the mathematical topics in general chemistry are relegated, are science majors and other students required to take two semesters of chemistry by their major plus a few hardy non-science souls. This presentation of general chemistry is particularly important to underprepared freshman since there is time for the student to finish a remedial mathematics course before applying the mathematics in chemistry.

SESSION 8.

The Prefix-Suffix Road to Word Power

Barbara Batty
Department of Science
Port Arthur Independent Schools
Port Arthur, TX

A major complaint of science students is that the vocabulary is too difficult and makes the subject more formidable than it should be. A basic prefix-suffix knowledge should help to overcome this. A workshop with over 30 handouts which will develop a series of working models with interchangeable parts of word formation, prefix-suffix games and applications that assist in better knowledge of word meaning and thereby a better language conceptual base will be provided.

SESSION 9.

The Role of a Science Learning Center in the Teaching of Science

A.H. Benham
Department of Chemistry
The University of Texas at Arlington
Arlington, TX

The interest in studying science and the number of science majors is declining. This trend must be reversed. Our nation critically needs scientists and engineers. Innovative methods of teaching science will enhance the studying of science. Too frequently the traditional lecture approach results in high attrition rates and a low interest in science. Lecturing does not meet the needs of the individual. Self paced modules studied in a quiet area create a more favorable learning environment and an unpressured, comfortable atmosphere allows a student to learn at their own pace. Supplementary material closely coordinated with regular classwork appears to be a successful combination. The utilization of the Science Learning Center at The University of Texas at Arlington has escalated. Self study units are available in various formats and in all disciplines; biology, chemistry, geology, mathematics, physics and psychology. One of the most popular is a videotape series in calculus. The self study materials are excellent for adult education. No other method of learning can accommodate and assist such a large variety of students.

SESSION 4.

Is There "Life" after Freshman Biology at a 2-year College?

John Berry
Wilbur Wright College
Chicago, IL

With more students shifting to technical/occupational careers and with increasing numbers of 2-year terminal degrees, can academic courses in science beyond the traditional introductory biology course still survive at our community colleges? Faced with lowered entrance scores, budget constraints, and declining enrollments, some 2-year college administrators advocate discontinuing sophomore lab courses in biology. This paper contends that lab and field courses in biology and environmental sciences are important and ought not to be discontinued. Instead, such courses can be refocused on local-scale issues and local investigative studies. If put into the form of Mastery Learning Modules through which all students can achieve at least some level of mastery, student retention and academic successes will follow. Thus, "life" after freshman-level biology at a 2-year college is possible.

Field Biology and Ecology (Biol 200) at Wright College provides a model showing that non-traditional (non-lecture) approaches can help students with widely different backgrounds and academic preparation to complete sophomore lab courses at a 2-year college. Biol 200's mastery modules strategy incorporates experiential learning with self-paced and investigative study, and suggests an example that other field or lab courses might follow. The presenter will review and summarize Biol 200's content, methods, and results after 10 years of teaching this course.

SESSION 3.

Factors Affecting College Students' Performance on Proportional Reasoning Problems

Frances P. Collea
Department of Science Education
California State University
Fullerton, CA

The purpose of this study was to investigate the effects of three variables on the proportional reasoning abilities of college students who vary in cognitive style. The first variable studied was type of information. The effects of four types of information were examined. They were: (1) relevant only, (2) relevant-irrelevant, (3) redundant, and (4) redundant relevant-irrelevant.

The second variable was type of proportional reasoning problem. Inhelder and Piaget have indicated that the ability to solve proportional reasoning problems based on physical equilibrium emerges prior to those based on geometry. By including problems of both kinds, it could be determined if a previously found interaction between cognitive style and reasoning ability was dependent on the type of problem.

Finally, educational background of students was included as a variable. By comparing the performance of science and non-science majors, familiarity with content could be controlled.

The research findings of this study have direct implications for curriculum development at the college level. Results of the study indicate that the major focus on the development of proportional reasoning in college students may not be solely the acquisition of the schema. Students need to learn to (1) recognize the critical aspects of problem situations which require the use of proportional reasoning schema, and (2) disembed relevant information from complex arrays containing irrelevant information.

SESSION 10.

Scientific and Technical Writing: How to Improve Your Skills

Robert A. Day
Director, ISI Press
3501 Market Street
Philadelphia, PA

John G. Truxal
Distinguished Professor of Engineering
Department of Technology & Society
State University of New York
Stony Brook, NY

Walter Cory
Coordinator
for School Sciences
Indiana University
Bloomington, IN

One objective of science teaching at all levels has been, for many decades, the improvement of communication skills. Yet today, we find that this is an area in which many students and some professional writers are woefully inadequate. In this session, we will describe means by which science teachers can best help their students to improve their writing skills. Experienced writers and editors will discuss some of the common difficulties encountered in writing about science for various groups including other scientists, students, and the general public. Participants will receive suggestions which can help them to improve their writing, also.

SESSION 1.

Intellectual Development and Learning Science: The Implications of William Perry's Theory for Science Teachers

Michael P. Donovan and Robert D. Allen
Department of Biology
West Virginia University
Morgantown, WV

Many students typically experience considerable difficulty when required to critically examine evidence, establish a line of reasoning, and reach a conclusion. Causes of these difficulties seem to be deeper than lack of content background and suggest fundamental misperceptions of the roles of evidence and reasoning in science. Insight into many of these difficulties has been provided by the work of William Perry on the intellectual development of college students. In general, development proceeds through a series of well-defined stages from dualistic to pluralistic views of knowledge and learning.

We have investigated the relationship among 1) students' level of intellectual development as defined by Perry's scheme, 2) students' ability to practice critical thinking with problems in biology, and 3) students' views on the nature of science and learning science. These results will be described as well as the implications for improving biology instruction.

This study was supported by NSF RISE Grant No. SED80-26487.

SESSION 7.

Using Laboratory Units Based on Gagne's Learning Hierarchy in General College Chemistry

Kay M. Elsen
Department of Chemistry
Mount Mary College
Milwaukee, WI

It is apparent to instructors faced with the teaching of chemistry to college freshmen that a substantial number of these students find the subject matter difficult and unintelligible. Part of the blame for the underachievement can be placed on the lack of intellectual development of these students.

Today many college science teachers have addressed themselves to this situation by using methods of instruction that provide advantageous learning encounters. This study involved laboratory procedures based on a learning hierarchy proposed by Robert Gagne. The Gagne model proposes that capabilities are learned in a sequential manner where previously learned subordinate capabilities transfer to the acquisition of superordinate capabilities. The last stages of the learning hierarchy, which were the focus of the study, are: concept learning, rule or principle learning, and problem solving.

Each laboratory unit, consisting of three sections, was designed to facilitate the learning of a specific abstract concept such as the mole. In the concept learning section, all of the prerequisite concepts were illustrated and presented. Using the foundation built by the concept learning stage, the principle (e.g. the mole) was defined and demonstrated by hands-on experiences. In the third section problem solving activities such as synthesis, analysis, and application of the principle to original strategies demonstrated the learner's level of understanding.

This study attempted to make learning less difficult and more meaningful by providing a laboratory experience based on a current learning theory. With continuing exploration of the wide spectrum of unique teaching strategies, the science community can assess and strengthen students' cognitive styles.

SESSION 7.

Implementation of a Cognitive Style Assessment Program in College Biology Courses

Mary Jo Fourier
Department of Biological Sciences
Johnson County Community College
Overland Park, KS

This paper will describe a cognitive style assessment program being utilized at Johnson County Community College in selected Biology courses. Cognitive style refers to the way in which a person seeks and acquires meaning; it is often considered synonymous with learning style.

Following brief introductory remarks describing cognitive style, three aspects of the program will be discussed. First, the instrument as well as the simple procedures used in administering and scoring it will be considered. Although not a necessity of a program, a computer-generated cognitive style map will be illustrated. Secondly, the procedures for disclosure to students of the results of the instrument will be presented. Prior research has shown that disclosure (knowledge of results) of cognitive style information has statistically significant effects on student achievement. Finally, the utilization of the cognitive style information by the instructor to better match instructional mode to the cognitive styles of class members will be summarized.

SESSION 2.

Integration of Environmental Science and Environmental Studies Programs

Orin G. Gelderloos
Department of Natural Science
University of Michigan-Dearborn
Dearborn, MI

Students with environmental interests have wide-ranging career goals and require training as generalists as well as specialists. Several years ago our institution developed two environmental programs to meet these needs. The Environmental Science program emphasizes the biological and physical and the Environmental Studies program stresses the humanities, social sicences, and behavioral sciences. To avoid over-specialization and isolation students in both programs are required to interact in environmental core courses designed to demonstrate the interdisciplinary nature of environmental problem solving and the necessity of wholistic thinking. A vital requirement of both programs is the internship which is structured to meet individual students' career goals. A senior thesis and seminar which involve peer review provide opportunity for students in both programs to develop integrative skills while pursuing their speciality. Program requirements, course outlines, internship positions, and careers of graduates will be presented.

SESSION 5.

Must College Science Teaching Be Such a Bore?

Leonard C. Grotz
Chemistry Department
University of Wisconsin Waukesha County Center
Waukesha, WI

College chemistry teachers have long noted that their beloved chemistry fails to motivate most (sometimes all) of their students in chemistry. Recognition of this fact has led many teachers to give courses that include or deal exclusively with historical anecdotes, relevant chemistry, or the chemistry of specific areas such as art, pollution, medicine, the atmosphere, the chemical industry, etc. Perhaps the real reason for the lack of interest of students is the manner in which chemistry is normally presented to them; that is, as an infinite number of isolated bits of dogma. Chemistry students are never invited to participate in the basic reasoning of chemistry, but rather are presented with the results as so much gospel to be digested and regurgitated upon demand. This is in stark contrast with other disciplines such as philosophy, English, or sociology in which students are allowed to think thoughts and express opinions that are contrary to the views of the teacher. This paper will deal with a number of items in chemistry and science where a different apporach to teaching invites the students to actively mentally participate in chemistry rather than to be just sponges for chemical facts, principles, and procedures.

SESSION 8.

Clinical Applications Projects (CAPS) for Health Science Students in Introductory Microbiology

Rebecca A. Halyard
Department of Biology
Clayton Junior College
Morrow, GA

Microbiology courses for health-science students generally emphasize the relationship between microbes, health, and disease. Laboratory projects have been developed that allow students to apply introductory principles and skills learned in lecture and laboratory to a problem in an appropriate clinical situation. Nursing students are provided with "unknowns" isolated from simulated patients. Dental Hygiene students work with organisms collected under a variety of situations in their clinic. Students in both programs are therefore able to directly use the microbiology in a specific situation that is familiar to them. Projects were developed by the author using input from faculty in the clinical areas. Effort was made to reinforce principles and processes emphasized in both microbiology and the clinical areas, and to stress the interaction between the basic and clinical sciences.

Students work independently on their projects during assigned laboratory or clinical periods, and require a minimum of supervision and supplies. Projects are completed in two to three weeks. Each student prepares a final written report of findings and conclusions, including suitable references.

Student response to the projects has been positive, with almost all students carrying out the project in a satisfactory manner. The projects have been used in the classes of several microbiology professors and all have found them to run smoothly.

This presentation will describe the projects and the procedures used to develop and refine them. Problems and limitations will also be identified.

SESSION 2.

Evaluation of a Mastery Program of Individualized Learning Modules

Linda K. Jones and Orin G. Gelderloos
Department of Natural Sciences
University of Michigan-Dearborn
Dearborn, MI

Students in introductory and advanced biology, chemistry, and physics courses are required to master specific skills and laboratory instrumentation before attending the laboratory or before receiving a grade in the course. These skills, such as semi-logarithmic graphing, oscilloscope operation, and propagation of uncertainties, are taught by means of individualized learning modules in a Science Learning Center (SLC) operated by a fulltime supervisor and eight part-time student assistants. The SLC houses some 40 learning modules on a wide range of sharply-focused topics. (Titles will be available at the presentation). Each module requires 20-30 minutes to complete, and includes a post-test to demonstrate mastery. Nearly 6,000 student visits are made each year. The SLC is open 70 hours per week and students make appointments to study the modules.

Evaluation of the project indicates that faculty save valuable time in the laboratory by not repeating instructions many times each session and in their offices by not correcting mistakes students make on material and skills they should have learned previously. Instruments, such as analytical balances and spectrophotometers, now require repair at only a fraction of the previous rate saving both time and money. Student evaluations demonstrate that the program is well received and that the students appreciate the opportunity to learn a topic concisely and efficiently, as well as being on an equal level with their peers regarding course pre-requisites. Student performance on laboratory report writing has improved markedly.

SESSION 4.

Physiological Correlates for Debilitating and Facilitating Testing Stimuli

William J. Kermis
Department of Science Education
The University of Texas at Dallas
Richardson, TX

Introduction

Direct measurement of physiological changes in subjects during a test is an innovative approach to understanding the nature of test anxiety. Subjects' verbal introspective reports of worry, tension and nervousness were used to isolate debilitating and facilitating testing stimuli (Kermis, 1980). Although verbal introspective reporting is widely accepted for social science and educational research, it is, none-the-less, an indirect method. Therefore, current research focus has included direct observation via subjects' physiological responses to those testing stimuli.

Conceptual Bases of the Research

Anxiety was described by Freud (1933) as an affective state of nervousness accompanied by behavioral manifestations (i.e., sweating). Suinn (1965) reported that students who experienced elevated levels of general anxiety also experienced elevations in test anxiety. Although theorists suggest an association between affective and physiological responses, the literature is void of empirical evidence.

The following research hypotheses serve as a priori decisions:

H_1: There are a set of stimuli which result in an increase in autonomic activity.

H_2: There are a set of stimuli which result in a decrease in autonomic activity.

H_3: Stimuli which either increase or decrease autonomic activity are dependent on the subject's propensity to be high or low test anxious.

Implications

The results of this research are both theoretical and applied. The theoretical implications contribute to a further conceptualization of a model of high and low test anxiousness. An applied benefit is to enable science faculty to assist their students who experience anxiety before and during a test.

SESSION 10.

The Successes and Failures of Teaching a Blind Student Anatomy and Physiology at the Community Collegee

Ed Krol
Biology Department
Henry Ford Community College
Dearborn, MI

Communication occurs at all cognitive levels. Being sighted all of my life makes me "average" but, when a student has been blind all of her life, she is not the average. Such a person was a student of mine in a two semester Human Anatomy and Physiology course. During this period, I conducted the course without compromising the educational processes nor the amount of academic material that was to be accomplished. My initial reaction was one of academic fear. Although, as supportive services were provided by our Special Needs Department of the college, I became more comfortable.

My objective in this presentation is to share teaching experiences, apprehensions, and ideas with interested colleagues. Photographs will be used with an explanation of teaching methods. Handouts, supportive services, suggestions, and other academic involvements with this enlighting student will also be discussed.

SESSION 3.

Societal and Educational Applications of Biological Concepts

William C. Kyle, Jr. and John E. Penick
Science Education Center
The University of Iowa
Iowa City, IA

In dealing with controversial and ethical issues in the biological sciences, this course, currently being offered at The University of Iowa, is appropriate and relevant for non-science majors as well as science majors and prospective or inservice elementary and secondary science teachers.

One of the major goals of this course is to increase students decision-making consciousness of the ethical issues in the biological sciences through exposure to a range of topics, themes, and alternative approaches. The students identify and define moral issues in the biological medical sciences and develop and apply a personal, logical, and rational framework for evaluating alternatives and relating moral principles to specific issues and cases.

Bioethics has arisen as a interdisciplinary field, one of the few where cooperation and discourse across the usual boundaries have been both intense and fruitful. It has attracted people working in theology, philosophy, and law as well as the social sciences, life sciences and various branches of the humanities. From a systematic point of view, the difficulty and pervasiveness of the issues invite the adoption of a broad ranging point of view. The educational process should encourage interdisciplinary approaches in a wide variety of educational applications of material presented in such courses. Societal and Educational Applications of Biological Concepts is an opportunity for students to begin making such wide ranging applications.

(Winner of the Gustav Ohaus Award for Innovations in College Science Teaching, 1981.)

SESSION 6.

The Structure of Knowledge: Its Relation to Effective Teaching and Learning

Ralph W. Lewis
Department of Natural Science
Michigan State University
East Lansing, MI

The structure of knowledge in the sciences and the other intellectual disciplines consists primarily of the structure of theories plus the relations between theories. Each theory consists of facts and ideas interconnected by lines of reasoning that may use facts to support the ideas and may use the ideas to explain and predict facts. The relations between theories are such that each theory may be categorized as major theory, over-theory, subtheory, accessory theory, parallel theory, competing theory, subsumed theory, or sequential theory. A theory may belong to more than one category depending on the context in which it is considered. The most effective organization and presentation of courses and the most effective and intellectually active learning by students is achieved when knowledge is explicityly structured to display facts, ideas, and reasoning. Examples will be given to support this thesis.

SESSION 7.

Freedom's Greatest Myth: Human Rights

Theodore Lopushinsky
Department of Natural Science
Michigan State University
East Lansing, MI

In a world increasingly threatened from the irreversible environmental damage produced by humans, it is not only paradoxical but dangerous to accept the increasing cries regarding human rights. Regardless of the many statements to the contrary, the excessive human population's quest for food, space, national and political identity, etc., is the primary cause of the world's biological destruction and most likely its political and social unrest.

Yet, decision-makers strive for what is good in human terms rather than what is true in ecological terms. Confirmation by political and religious leaders has made human rights a postulate of policy.

This presentation questions the terms rights in the absence of responsibility and obligation. The former is dangerous in that it emphasizes a flow of effort towards the individual from society and/or nature. This equalitarian artifact ignores biological priority and merit. In contrast, the latter terms focus on the outward flow of individual accountability towards society and/or nature.

By way of illustration, the foremost human right -- the freedom to procreate -- is examined regarding this simple but critical shift in words.

SESSION 6.

Difficulties with the Punnett Square Approach to Solving Mendelian Genetic Problems

Michael B. Moll
Department of Biology
West Virginia University
Morgantown, WV

Most introductory high school and college biology courses utilize the Punnett Square approach to aid students in solving Mendelian genetics problems. Students tend to use this approach as an algorithm and as a result have some difficulties in their ability to deal with unfamiliar genetic problems. College students in introductory biology appear to have two fundamental difficulties even though they can arrive at many "correct" answers using the Punnett Square problem-solving method. The students:

1) cannot relate meiosis, gamete formation, and gamete combination to correctly produce the frequency of progeny types in the next generation.

2) tend to respond with a particular frequency of progeny types that were recognized as patterns of Punnett Square problems presented in class.

Current investigations involve studying student difficulties in relating the meiosis of parental genotypes to gamete formation and subsequent combination of gametes in the production offspring.

SESSION 9.

The Cost of Solar Energy

H. Kent Moore
Department of Physics
James Madison University
Harrisonburg, VA

The specific object of the workshop will be to examine the cost-effectiveness of solar heat collecting systems when used for space heating and hot water.

It would incorporate elements from the various fields of physics, meteorology, engineering, and economics, and serve to demonstrate the interface between science and other disciplines when applied toward problems of society.

The methodology for design of a solar heat collecting system will be developed using the physical and economic parameters of a) anticipated energy demand, b) availability of solar flux, c) cost (present and anticipated future) of conventional energy, and d) financing mortgage costs for a solar heat collection system.) The concepts of life-cycle cost and pay-back period will be considered as two criteria that may be used in evaluating the merits of a solar heat collection system when compared with a conventional system.

A portion of the workshop session will be devoted to a sample-case problem activity with participants.

SESSION 5.

BioConcepts, A Remedial Biology Course for College Freshmen

Jeanette S. Mullins
California State College
California, PA

BioConcepts is a remedial course for college freshmen majoring in biology at California State College in Pennsylvania. Students are placed in BioConcepts on the basis of a combined SAT score of 800 or less. This course is designed to prepare students for the usual introductory biology course. In this paper a three year overview of teaching experiences in BioConcepts is presented.

The special problems of these students have been identified. By utilizing various learning theory methodologies, solutions to many of these problems have been discovered.

SESSION 2.

Teaching Chemistry of Life Processes to a Heterogeneous Student Population

Jerry L. Sarquis
Department of Chemistry
Miami University
Middletown, OH

Chemistry of Life Processes is a one semester nonscience majors' course at Miami University. This course covers topics in general, organic and biochemistry. The Middletown Campus of Miami University is a two year commuter campus with an open enrollment policy. The students are a mix of traditional and mature students. They come with a wide range of abilities and career goals, and often have no or little background in chemistry. A majority have work and/or family responsibilities in addition to their academic load.

Because of the heterogeniety of the students, a variety of teaching strategies, learning aids, and supporting resources are used for this course. These have evolved over a period of years as a result of analysis of student classroom performance and their attitudes and perceptions. Students are encouraged to pick and choose the learning materials that suit their personal preferences. Course materials include: a detailed study calendar; learning objectives keyed to course topics and textbook exercises; quizzes and post-quiz reports suggesting specific areas of study and review for exams; a series of audio tape workbooks for supplemental study of difficult concepts; a guide to effective studying; and lecture demonstrations.

SESSION 8.

The Development and Use of a Self-Instructional Zoo and Museum Module as a Teaching Tool for Principles of Classification and Ecological Adaptation

Angela M. Sauro
Department of Biology
Mount Mary College
Milwaukee, WE

In a recent curriculum project for a Natural Science for Elementary School Teachers Course two self-instructional modules were developed which make use of local resources, the zoo and museum, to study principles of classification and ecological adaptation.

Each module consists of a series of objectives expressed in terms of competence, a rationale for each objective, a set of readings and a set of learning and zoo or museum activities.

The students took part in a brief evaluation of the modules upon completion of the modules.

The use of these two self-instructional modules allowed for self-pacing and individual thinking on basic biological concepts which are sometimes difficult to teach in a creative way. They also exposed students to two very fine local resources available to them as future teachers.

SESSION 3.

Spatial Visulization Training Improves Performance in Organic Chemistry

Melinda V. Small
Department of Psychology
Bowdoin College
Brunswick, ME

All members of an organic chemistry class were divided into two matched groups on the basis of the scores of five spatial tests. Both groups were given training materials for the first eight weeks of the semester. One group received materials that were designed to develop spatial visualization skills. This training included building and manipulating three-dimensional models, drawing and interpreting two-dimensional models, and imagining the manipulation of the models. The other group had materials that emphasized chemical nomenclature. All students had a commercial chemical model kit available to them. The first class examination was given five weeks into the semester and did not include problems that involved stereotaxic models. There was no difference between the two training groups on this examination. The final examination grades for the course indicated a very different picture. The male students with spatial training had grades 20% higher than the other males, a significant difference. The female students showed a 10% improvement, not significant. Most instructors of organic chemistry recognize the important role of spatial visualization skills. Our research supports this impression and demonstrates that training can benefit college students.

SESSION 10.

What to do With the Non-Resident Term: Internship Program for College Students at the Brooklyn Botanic Garden

Paula J. Thompson
Brooklyn Botanic Garden
Brooklyn, NY

The Brooklyn Botanic Garden has long recognized that a most important part of the college curriculum is the application of knowledge and skills acquired in the classroom to jobs in the outside world. For most of its seventy-one years, the Garden has been a place where college students can participate in their own educational process by serving as interns in education, horticulture, or research. Although the specific kinds of work assignments have changed over the years, the Garden's commitment to the value of such internships has not altered.

An audiovisual presentation describing the internship programs at the Brooklyn Botanic Garden and its outreach stations on Long Island and in Westchester County will be presented. Information and application materials for teachers to bring back to their students will be available.

SESSION 6.

Putting Investigation Into The Science Laboratory

Leona C. Truchan, Wendell Kringen, Jean Schafer, and George Gurria
Natural Science and Technology Division
Alverno College
Milwaukee, WE

Alverno College has committed itself to the implementation of an outcome-oriented approach to learning since 1972. From 1978, a team of faculty members from the science and technology division has attempted to develop problem solving skills in the scientific mode through the design and implementation of the Investigative Learning Laboratory Experience. This investigative experience is an "open-ended" laboratory design focusing on scientific problem solving and self-learning.

Members of the Natural Science and Technology Division have created a model of investigation and have implemented it in more than fifteen science laboratory courses. The model is adapted to lower and upper level courses and applies both to students majoring or minoring in the sciences or those taking science courses to complete their general education requirements.

SESSION 4.

Art Forgeries and Science

William D. Wilk
Department of Chemistry
California State University, Dominquez Hills
Carson, CA

Attitudes vary among Art Curators, Art Historians, Art Conservationists and Scientists as to what constitutes an art forgery and how much and what type of testing is needed to prove a forgery. Most notable among forgers was Han van Meegeren (1889-1947). Modern methods of sleuthing include surface examinations of objects with raking light, u.v. light and light microscopy which reveal "hidden" details. Special techniques like infrared reflectance photography, x-ray photography, x-ray fluorescence, thermoluminescent dating, and neutron activation autoradiography expose even the most discrete forgery. Numerous slides will be used to illustrate the effects revealed by the non-destructive methods of examination of art works.

SESSION 9.

UNCLOS, Third World, and Transfer of Technology

Ralph Yalkovsky
Department of Geosciences, Physics and Interdisciplinary Sciences
State University College at Buffalo
Buffalo, NY

The third United Nations Conference on the Law of the Sea (UNCLOS) is the most important technical conference in history. The "Common Heritage" doctrine may lead to a revolutionary new international institution -- The International Sea Bed Authority -- which will mine, benefeciate and market manganese modules from the deep ocean floor. Proceeds from this operation will be apportioned among all nations with special emphasis for the needs of developing nations.

These Third World countries desire technology transfer rather than money benefit in order to raise their standard of living as well as to be able to compete with advanced nations. Article 202 of the revised negotiating text states in part:

States shall directly or through competent international organizations:

a) Promote programmes of scientific, educational, technical or other assistance to developing states for the protection and preservation of the marine environment and the prevention, reduction and control of marine pollution. Such assistance shall include, inter alia:

(i) Training of their scientific and technical personnel;
(ii) Facilitating their participation in relevant international programmes;
(iii) Supplying necessary equipment and facilities;
(iv) Enhancing the capacity of developing States to manufacture such equipment,
(v) Developing facilities for and advice on research, monitoring, educational and other programmes;

SESSION 5.

PROGRAM AND ABSTRACTS

SCST SPONSORED SYMPOSIUM ON FEDERALLY FUNDED PROJECTS IN COLLEGE SCIENCE TEACHING

APRIL 1, 1982

Abstracts are listed in alphabetically by first author beginning on page 25
[All Sessions are in *The Conrad Hilton Hotel*]

SESSION I.

Parlor 414

Presiding: Gerald Summers
Division of Biological Sciences
University of Missouri
Columbia, MO

9:00-9:05 Opening Remarks

9:05-9:20 IMPROVING EDUCATION TO KEEP UP WITH MODERN TECHNOLOGY

Suzan McCoury, Department of Science-General Education, Mayland Technical College, Spruce Pine, NC.

9:25-9:40 UNDERGRADUATE ORGANIC LAB COURSES: A SURVEY

Janet Bennet, Department of Chemistry, Oakland University, Rochester, MI.

9:45-10:00 SMALL CONSTRUCTION GRANTS - CHALLENGES, FRUSTRATIONS and SUCCESSES

Thomas E. Brown, Department of Science and Mathematics, Atlantic Community College, Mays Landing, NJ.

10:05-10:20 EFIELD - AN EXAMPLE OF A COMPUTER TUTORIAL AT UDC

Edward H. Rogers, Jr. and Daryao Khatri, Department of Physics, University of District of Columbia/MVSC, Washington, DC.

10:25-10:40 COMPUTER SIMULATIONS AND DIALOGS IN PHYSICS AT UDC

Daryao S. Khatri and Edward H. Rogers, Jr., Department of Physics, University of District of Columbia/MVSC, Washington, DC.

10:45-11:10 Coffee

11:10-11:25 APPLICATIONS OF MICROCOMPUTERS IN SCIENCE EDUCATION

Daniel Davidson and David Stefan, Center for the Instructional Use of Microcomputers, Pima Community College, Tucson, AZ.

11:30-11:45 COASTAL-ENVIRONMENTAL STUDIES

Elaine Wallace, Department of Coastal-Environmental Studies, Wayne County Community College, Detroit, MI.

11:50-12:05 COMPUTER LITERACY - A WORKING MODEL

Fred Kollett, Director, Computer Literacy Project, Wheaton College, Norton, MA.

12:10 Adjourn for Lunch

SESSION II.

Parlor 415

Presiding: Robert K. James
Department of Curriculum & Instruction
Kansas State University
Manhattan, KS

9:00-9:05 Opening Remarks

9:05-9:20 MICROCOMPUTERS AS A CLASSROOM TEACHING AID

Pratul K. Ajmera, Department of Electrical Engineering, University of Notre Dame, Notre Dame, IN.

9:25-9:40 LABORATORY COURSEWARE FOR APPLIED SOLAR ENERGY COURSES

Ronald M. Cosby, Department of Physics and Astronomy, Ball State University, Muncie, IN.

10:05-10:20 THE ROLE OF TELEVISION AND COMPUTER IN UNDERGRADUATE SCIENCE EDUCATION

Buddhadev Sen, Department of Chemistry, Louisiana State University, Baton Rouge, LA.

10:25-10:40 PREPARING COMPUTER AIDED INSTRUCTION LESSONS BY COMMITTEE

Dorothy Sinise, Department of Physical Science, Amarillo College, Amarillo, TX.

10:45-11:10 Coffee

11:10-11:25 COMPUTER GRAPHICS: ENHANCEMENT OF SCIENCE EDUCATION

L.V. Brillhard and E. Bell, Department of Science and Engineering, Triton College, River Grove, IL.

11:30-11:45 LABORATORY EXPERIENCES IN NATURAL SCIENCE FOR NON-SCIENCE MAJORS

Sister Marquita Barnard, Department of Chemistry, The College of St. Catherine, St. Paul, MN.

11:50-12:05 DEVELOPMENT OF A SCIENCE AND TECHNOLOGY COURSE FOR UNDERGRADUATE NON-SCIENCE MAJORS

Ann T. Lemley, Department of Design and Environmental Analysis, Cornell University, Ithaca, NY.

12:10 ADJOURN FOR LUNCH

SESSION III.

Parlor 418

Presiding: L. Jewel Nicholls
Department of Chemistry
University of Illinois at Chicago
Chicago, Il

9:00-9:05 Opening Remarks

9:05-9:20 VIDEOTAPES FOR ENVIRONMENTAL GEOLOGY

Glenn W. Frank, Department of Geology, Kent State University, Kent, OH.

9:25-9:40 COMPUTER ASSISTED INSTRUCTION IN EARTH SICENCE

Henry Lepp, Department of Geology, Macalester College, St. Paul, MN.

9:45-10:00 CAI IN ENVIRONMENTAL STUDIES

Dennis M. Richter, Department of Geography, University of Wisconsin at Whitewater, Whitewater, WI.

10:05-10:20 TRAINING IN POLICY ANALYSIS FOR UNDERGRADUATES

B. Pakizegi, Department of Psychology, William Paterson College of New Jersey, Wayne, NJ.

10:25-10:40 SIMULATING THE EFFECTS OF ECONOMIC POLICY CHANGES: CLASSROOM IMPLEMENTATION OF A MACRO-MICROECONOMIC POLICY ANALYSIS MODEL

Edward M. McNertney and C. Richard Waits, Department of Economics, Texas Christian University, Fort Worth, TX.

10:45-11:10 Coffee

11:10-11:25 A NSF-LOCI INTRODUCTION CHEMISTRY LABORATORY IMPROVEMENT PROJECT AT HOPE COLLEGE

Irwin J. Brink, Department of Chemistry, Hope College, Holland, MI.

11:30-11:45 RESISTING TECHNOLOGICAL OVERKILLS: SIMPLE ALTERNATIVES TO VIDEO TAPE

George M. Bodner, Department of Chemistry, Purdue University, West Lafayette, IN.

11:50-12:05 POLITICAL SCIENCE INSTRUCTION AND THE PLATO MEDIUM

Richard T. Sylves, Department of Political Science, University of Delaware, Newark, DE.

12:10 Adjourn for Lunch

SESSION IV.

Parlor 419

Presiding: Helen Koritz
Biology Department
College of Mount St. Vincent
Riverdale, NY

9:00-9:05 Opening Remarks

9:05-9:20 USING C.A.I. TO INTRODUCE A DICHOTOMOUS CLASSIFICATION SYSTEM AND IDENTIFICATION KEY

Robert T. Ward, Department of Physics, University of Northern Iowa, Cedar Falls, IA.

9:25-9:40 USING C.A.I. IN ENVIRONMENTAL BIOLOGY

David McCalley, Department of Biology, University of Northern Iowa, Cedar Falls, IA.

9:45-10:00 USING C.A.I. TO PRESENT A GRASSLAND ECOLOGICAL SIMULATION

Daryl D. Smith, Department of Biology, University of Northern Iowa, Cedar Falls, IA.

10:05-10:20 USING THE "BITS OF INFORMATION PROBLEM" TO INTRODUCE THE SCIENTIFIC METHOD

Paul Barelski, Department of Natural Science and Mathematics, LeMoyne-Owen College, Memphis, TN.

10:25-10:40 THE INTEGRATED CHEMISTRY LABORATORY PROGRAM AT NEW MEXICO HIGHLANDS UNIVERSITY

Robert Amai, Ronald Clark, George Sprenger, Larry Sveum, Joseph Schufle, and Galen Ewing, Department of Science and Mathematics, New Mexico Highlands University, Las Vegas, NM.

10:45-11:10 Coffee

11:10-11:25 TECHNOLOGY ADVANCES AND THE UNDERGRADUATE LABORATORY

B.D. Huggins and T.L. Stewart, Department of Electrical Engineering and Electrical Engineering Technology, Bradley University, Peorta, IL.

11:30-11:45 THE ROLE OF THE SOIL MECHANICS LABORATORY IN UNDERGRADUATE CIVIL ENGINEERING CURRICULA

Vito A. Guido, Department of Civil Engineering, The School of Engineering, New York, NY.

11:50-12:05 A SOLAR LABORATORY - A KEY TO COMPREHENSION

Fred W. Emshousen, Department of Mechanical Engineering Technology, Purdue University, West Lafayette, IN.

12:10 Adjourn for Lunch

SESSION V.

Parlor 414
Presiding: Ted Lopushinsky
Department of Natural Science
Michigan State University
East Lansing, MI

1:25-1:30 Opening Remarks

1:30-1:45 INTERDISCIPLINARITY - A MEANS FOR REVITALIZATION OF AN ENVIRONMENTAL STUDIES PROGRAM

Charles W. Lee, Department of Chemistry, Physics, and Environmental Science, William Paterson College of New Jersey, Wayne, NJ.

1:50-2:05 THE NORRIE POINT PROJECT

Henry M. Muschio, Department of Biological Sciences, Dutchess Community College, Poughkeepsie, NY.

2:10-2:25 TESTOR: AN INSTRUCTIONAL MANAGEMENT AND STUDENT EVALUATION TOOL FOR PROGRAMS OF INDIVIDUALIZED INSTRUCTION

Gerald Summers, Division of Biological Sciences, University of Missouri - Columbia, Columbia, MO.

2:30-2:45 THE LAREDO JUNIOR COLLEGE RESEARCH SKILLS TRAINING PROGRAM

James M. Earhart, Department of Biology, Laredo Junior College, Laredo, TX.

2:50-3:05 VIDEO ENHANCEMENT OF MICROCOMPUTERS IN SCIENCE EDUCATION

Roger H. Geeslin, Department of Mathematics, University of Louisville, Louisville, KY.

3:10-3:25 MICROCOMPUTER SOFTWARE FOR USE IN THE SCIENCE AND MATHEMATICS CURRICULUM

Theron Rockhill, Director, Microcomputer Project, SUNY College at Brockport, Brockport, NY.

3:30 Adjourn

SESSION VI.

Parlor 415
Presiding: William M. Frase, University College
University of Cincinnati
Cincinnati, OH

1:25-1:30 Opening Remarks

1:30-1:45 WEBER STATE COLLEGE FIELD BASED GEOGRAPHY PROGRAM

Don R. Murphy, Department of Geology/Geography, Weber State College, Ogden, UT.

1:50-2:05 SCIENCE FOR THE UNDERGRADUATE NON-SCIENTIST

Richard Stebbins, Department of Chemistry, Bethany College, Bethany, WV.

2:10-2:25 LABORATORY SKILL DEVELOPMENT FOR PRESERVICE SCIENCE TEACHERS

Robert K. James, Department of Curriculum and Instruction, Kansas State University, Manhattan, KS.

2:30-2:45 HUMAN ANATOMY COURSE ADAPTATIONS TO MEET EMERGING STUDENT NEEDS

Mary Jo Fourier, Department of Biological Sciences, Johnson County Community College, Overland Park, KS.

2:50-3:05 UNDERGRADUATE LABORATORY IN SENSORY PHYSIOLOGY AND PERCEPTION

William A. Yost, Parmly Hearing Institute, Loyola University, Chicago, IL.

3:10-3:25 CASE STUDIES OF ACADEMIC COMPUTING AT MINORITY INSTITUTIONS

Beverly Hunter, Senior Staff Scientist, Human Resource Research Organization, Alexandria, VA.

3:30 Adjourn

SESSION VII.

Parlor 418
Presiding: Julia Riggs, Biology Department
Victoria College
Victoria, TX

1:25-1:30 Opening Remarks

1:30-1:45 DEVELOPMENT OF SCIENCE LEARNING MODULES USING C.A.I. AND THE POLAROID INTERACTIVE LECTURE SYSTEM

Glenn Y. Yoshida, Life Science Department, Los Angeles Southwest College, Los Angeles, CA.

1:50-2:05 CONSULTING FIRM SCENARIOS FOR MATHEMATICAL MODELING

George E. Strecker, Department of Mathematics, Kansas State University, Manhattan, KS.

2:10-2:25 PIAGET-BASED INTEGRATED MATH AND SCIENCE PROGRAMS

George Kolodiy, Department of Natural Science and Mathematics, Bloomfield College, Bloomfield, NJ.

2:30-2:45 LEARNING MATHEMATICAL AND STATISTICAL CONCEPTS THROUGH A PROGRAMMING LANGUAGE

Murray Eisenberg, Department of Mathematics and Statistics, University of Massachusetts, Amherst, MA.

2:50-3:05 SETTING UP A LOW-COST COMPUTER CENTER

Paul L. Baker, Department of Mathematics, Livingstone College, Salisbury, NC.

3:10 Adjourn

SESSION VIII.

Parlor 419
Presiding: Marvin L. Druger
Biological Research Labs
Syracuse University
Syracuse, NY

1:25-1:30 Opening Remarks

1:30-1:45 INTRODUCING THE MICRO COMPUTER INTO THE CHEMISTRY LABORATORY

Morris Taylor, Department of Chemistry, Eastern Kentucky University, Richmond, KY.

1:50-2:05 USE OF MODULAR UNITS IN INSTRUMENTAL ANALYSIS LABORATORY

Chia-yu Li, Department of Chemistry, East Carolina University, Greenville, NC.

2:10-2:25 IMPLEMENTATION OF MICROPROCESSOR BASED INSTRUMENTATION

Michael D. Seymour, Department of Chemistry, Hope College, Holland, MI.

2:30-2:45 BENEFITS FOR ALL IN A CHEMISTRY LABORATORY SAFETY COURSE

L. Jewell Nicholls, Department of Chemistry, University of Illinois at Chicago, Chicago, IL.

2:50-3:05 SAN ANTONIO PREFRESHMAN ENGINEERING PROGRAM

Manuel P. Berriozabal, Division of Mathematics, Computer Science, and Systems Design, The University of Texas at San Antonio, San Antonio, TX.

3:10-3:25 VIDEO MODULES WITH COMPUTER GRAPHICS FOR PRECALCULUS

Edward M. Landesman, Department of Mathematics, University of California at Santa Cruz, Santa Cruz, CA.

3:30 Adjourn

Microcomputers as a Classroom Teaching Aid

Pratul K. Ajmera
Department of Electrical Engineering
University of Notre Dame
Notre Dame, IN

Science teachers have always made use of demonstration models and other aids for improving the effectiveness of classroom teaching. A judicious use of these devices in a classroom often makes the subject matter more plausible and meaningful to students. In this paper, we examine microcomputers as a new and a formidable tool for classroom teaching. Computers have been used extensively for teaching purposes in a number of ways such as solving home assignment problems, testing and grading student performances and in laboratories. The recent availability of inexpensive, portable microcomputers with associated graphic display devices now makes it possible to use these computers for classroom teaching as well. This paper describes the use of microcomputers as a teaching aid in the classroom. The observations made on an on-going program at the University of Notre Dame in the use of microcomputers in teaching junior level electrical engineering students is described. Specific working examples in the in-classroom use of interactive computer programs with graphic displays will be presented on a portable microcomputer system to demonstrate the effectiveness of this tool as a classroom teaching aid.

SESSION II.

The Integrated Chemistry Laboratory Program at New Mexico Highlands University

Robert Amal, Ronald Clark, George Sprenger, Larry Sveum, Joseph Schufle, and Galen Ewing
Department of Science and Mathematics
New Mexico Highlands University
Las Vegas, NM

Through a MISIP grant which was awarded to New Mexico Highlands University, a reorganization and modernization of the laboratory work associated with the first three years of chemistry courses was undertaken. Six new laboratory courses, to be taken sequentially and titled simply Integrated Laboratory I - VI, were developed. Among the objectives addressed by the reorganization were: 1) deletion of the repetition of concepts among experiments; 2) introduction of more instrumentation at an earlier time; 3) exposure of beginning students to experimental concepts and procedures traditionally included in our later laboratory courses, thereby better accommodating the needs of chemistry minors and other non-majors; and 4) preparation of chemistry majors to undertake laboratory research projects in their senior year. MISIP support was provided for equipment and instrument acquisitions necessary for the up-dating and reorganization of the laboratory curriculum. Comments on the successes and short-comings of the new program will be included in the presentation.

SESSION IV.

Setting Up a Low-Cost Computer Center

Paul L. Baker
Department of Mathematics
Livingstone College
Salisbury, NC

How to set up a low-cost computer center
Giving science students electronic mentors
Take a wistful journey through slides and verse--
it all began on October the first.
Like Old Mother's cupboard, the room was quite bare,
Not a bit or a byte or ROM could be found there.
But by Thanksgiving of "80" the room was afire
With 25 micros interconnected with wire,
And printers and plotter and disks which are floppy,
And one project director who could not be more hoppy;
For not just equipment packed into the space,
But so did the students--success filled the place.

SESSION VII.

Using the 'Bits of Information Problem' to Introduce the Scientific Method

Paul Barelski
Department of Natural Science and Mathematics
LeMoyne-Owen College
Memphis, TN

Suprising (almost amazing) interest was shown by students in the introductory Physical Science laboratory when given the "Bits of Information" problem to solve. Students working in groups (of six) are given different bits of an investigation involving the scientific method. One student is given the group's assignment, some have irrelevent bits of information. Members of the group have to verbally communicate their information to solve the puzzle which is to list in order the steps of the investigation according to the scientific method. Several such problems have been developed. The students get involved, see the need for communication, and also realize that there are many parts or aspects to a problem that must be pulled together.

SESSION IV.

Laboratory Experences in Natural Science for Non-Science Majors

Sister Marquita Barnard
Department of Chemistry
The College of St. Catherine
St. Paul, MN

Laboratory experiences for two semesters of the interdisciplinary science course, Introduction to Natural Science, have been developed during two summers. The experiments mesh with the lecture component of the course and have been in use during the past two academic years.

The course fulfills the liberal arts requirement for a natural science. Faculty members from physical education, home economics, occupational therapy, and elementary education worked with members of the science departments to determine which topics should be covered in such a general course. Therefore, there is a broad spectrum of interests among the students who take the course. Instructors for the course are drawn from the chemistry and biology departments.

The main thrust of the course has been to provide the students with a general background in the physical, geological and biological sciences. To try to satisfy these requirements, experiments in measurement, mechanics, heat and chemistry have been developed for the first semester of the course, while experiments in biology, geology and meteorology have been devised for the second semester. Astronomy is taught during the January interim. Inexpensive equipment is used so that the focus is on basic concepts rather than on complex laboratory methods.

SESSION II.

Undergraduate Organic Lab Courses: A Survey

Janet Bennett
Department of Chemistry
Oakland University
Rochester, MI

One of the CAUSE projects undertaken by the Department of Chemistry at Oakland University was an inquiry into the teaching and grading of undergraduate organic lab courses. A 20 question survey was prepared and subsequently distributed to 284 colleges and universities throughout the country. The responses thus far have indicated more than a casual interest in this area, with a total number of replies, as of this writing, exceeding the 70% level. Pertinent questions, among others, dealt with the assessment of the students' techniques in the lab and the methods of evaluating the students' progress during the course of the lab. Results of this survey will be presented along with possible instructive conclusions to the teaching of organic laboratory courses.

SESSION I.

San Antonio Prefreshman Engineering Program

Manuel P. Berriozabal
Division of Mathematics, Computer Science, and Systems Design
The University of Texas at San Antonio
San Antonio, TX

The San Antonio Prefreshman Engineering Program (PREP) has been conducted each summer since 1979 on the campus of the University of Texas at San Antonio. The purpose of the program is to identify high ability ninth, tenth, and eleventh grade students and make them aware of opportunities in science and engineering. Special efforts are made to recruit minority and women students as participants. Each summer, over 75% of the participants are minority and over 33% are women.

The objective of the program is to develop abstract reasoning skills and problem-solving skills of the participants.

This program runs for 8 weeks, 5 days per week, 7 hours per day.

The program obtains its support from the US Department of Energy, UTSA, The University of Texas at Austin College of Engineering, The Texas Alliance for Minorities in Engineering, Inc., and local industries and agencies.

Local school systems award independent studies credit to successful participants. The local Summer Youth Employment Program (SYEP) sponsors have designated the program a worksite. Consequently, program participants who come from low income families and who qualify for the SYEP Program can count their program participation to satisfy the work requirements.

SESSION VIII.

Resisting Technological Overkills: Simple Alternatives to Video-Tape

George M. Bodner
Department of Chemistry
Purdue University
West Lafayette, IN

An enticing array of technological advancements have appeared in recent years in instructional media. Unfortunately, many of us can be accused (or indeed have been accused) of the young-child-at-Christmas syndrome. "If you'll buy me this new $1000 ($10,000 or $100,000) "toy", I'll never ask for anything again!" This can be readily excused, of course, because our sister institution, the University of Awesome Endowment, has reportedly bought $50,000 worth of these toys, and we obviously must do the same.

Unfortunately, we have not always paid attention to why other apparent technological advancements of the past decades have failed. We often forget that the medium is not as important as the development of important contexts for its use. And we seldom remember to carefully examine simpler, less expensive processes before adopting complex, sophisticated, and expensive systems.

In this paper we will provide several examples of the advantages of staying with simple 35 mm slide techniques rather than opting for video-tape technology, with particular emphasis on the purposes for which video-tape is presently being used. We will try to address the question of when do we resist new technology, or perhaps technological overkill, when designing new instructional techniques.

SESSION III.

Computer Graphics: Enhancement of Science Education

L.V. Brillhard and E. Bell
Department of Science and Engineering
Triton College
River Grove, IL

The impact of computer graphics on the student's learning process may roughly be divided into four categories:

1. Exploration of computer capability
2. Programming
3. Enhancement of visualization
4. Dynamic display

Visualization of static and dynamic conditions or processes by students is a well documented problem. Three-dimensional visualization is particularly critical because of the two-dimensional media used in education. Models frequently used to demonstrate three-dimensional static structures are usually limited to one or at best, a family of structures. The computer, on the other hand, can be programmed to display a virtually infinite number of models, which may be rotated, simulating viewing from any direction.

This paper will present methods of showing students the capabilities of microcomputers. Examples of static and dynamic computer simulations in chemistry and physics will be discussed. All examples shown are the results of programs written by students in BASIC, a language taught in the first semester of the freshman year in the engineering curriculum.

The material presented was developed under the auspices of an NSF CAUSE grant. An NSF/ISEP grant paid for part of the equipment used.

SESSION II.

A NSF-LOCI Introductory Chemistry Laboratory Improvement Project at Hope College

Irwin J. Brink
Department of Chemistry
Hope College
Holland, MI

The objective of the project was to produce a set of sequential, pretested experiments which introduces techniques of modern experimental chemistry, reinforces chemical principles in an intellectually stimulating way, stresses minimum costs for supplies and equipment, incorporates safety and environmental health practices, and utilizes recovery and recycling techniques where feasible. 18 experiments were written, tested, implemented in the laboratory, evaluated, and revised upon the basis of evaluations submitted by student and faculty users. The new set of experiments is considered to be superior (in terms of educational value, economy, safety and environment preservation) to the set used previously. A set of descriptions of special techniques and instrumentation used in the experiments was also written and compiled along with the experiments in a loose-leaf binder and made available to the student as the laboratory manual for the introductory chemistry laboratory courses, Chemistry 113 and 114. The newly developed materials constitute the curricular content of these two chemistry laboratory courses for science majors at Hope College. Responses of students and faculty to the new set of experiments are summarized and cost estimates given.

SESSION III.

Small Construction Grants - Challenges, Frustrations and Successes

Thomas E. Brown
Department of Science and Mathematics
Atlantic Community College
Mays Landing, NJ

A grant ($87,743) for small building construction, was awarded Atlantic Community College by NSF via CAUSE. The purpose of this award was to help finance construction of a greenhouse (42' x 35') and an animal maintenance facility (25' x 18'). These two structures were vitally needed to relieve the science preparation space and facilities and to provide students with suitable working areas. Construction problems included: internal delays, labor troubles, lack of bidding interest, and shipping holdups. Our gains were: experience, a much closer and more understanding relationship with the various involved college offices, and finally, completion of excellent units designed and built to fit our specific needs. Progress slides will be shown. Our problems and their solutions may be of interest to others either contemplating or involved in similar projects.

SESSION I.

Laboratory Courseware for Applied Solar Energy Courses

Ronald M. Cosby
Department of Physics and Astronomy
Ball State University
Muncie, IN

A three-course series in applied solar energy is offered at the senior level by the Department of Physics & Astronomy at Ball State University. Designed primarily for physics majors desiring research and development careers in the solar industry, these advanced courses require laboratory experiments with modern solar hardware to be effective as applied physics courses. The primary project objective is the development of laboratory experiments utilizing available solar equipment and formulation of accompanying instructional documentation.

In this paper, selected student experiments will be described including objectives, equipment, documentation, and outcomes. Observations and recommendations for continued improvement in the laboratory experiences will center on the need for specialized facilities and the necessity for flexibility in lab schedules. In the context of course improvement, progress on construction of the fifteen thousand square foot BSU Solar Energy Research and Educational Facility will be briefly reviewed.

SESSION II.

Applications of Microcomputers in Science Education

Daniel Davidson and David Stefan
Center for the Instructional Use of Microcomputers
Pima Community College
Tucson, AZ

Through funding provided in part by the National Science Foundation ISEP and CAUSE, Pima Community College has developed instructional uses of microcomputers in Anthropology, Astronomy, Chemistry, Computer Science, Economics, Mathematics, Physics, and Psychology. "Support" programs have been written to extend the capabilities of the computers used through augmented graphics and "scientific" notation. Extensive use has been made of the computer's ability to produce graphics based simulations.

In addition to demonstrating these materials, the process of setting up a center to promote educational microcomputer use will be discussed. This will include details concerning equipment, faculty and student training, and software development.

The application of microcomputers in Pima College's Field Archaeology Program will also be demonstrated. The microcomputer, housed in a four wheel drive vehicle, integrates information obtained from field instruments into a data base. Graphics output helps to provide students with direct confirmation and evaluation of field data.

SESSION I.

The Laredo Junior College Research Skills Training Program

James M. Earhart
Department of Biology
Laredo Junior College
Laredo, TX

We are involved in a program designed primarily to increase the flow of Mexican-American students into science careers. The program centers around small groups of students working with individual faculty members. Together they develop research problems within the faculty member's range of competence.

The objectives of the program are: (1) to acquaint students with tools and techniques used in biological research, (2) to help students develop skills in the use of laboratory equipment, (3) to involve students in the process of recognizing and developing a research problem, (4) to involve students in designing and implementing a controlled experiment, (5) to guide students in the art of communicating their experimental results to others, (6) to make students aware of Mexican-Americans who are successful in science.

Since the beginning of the program in September 1980, we have had a very successful seminar led by prominent Mexican-American researchers, a field trip to a major Health Science Center, and have participated in a statewide scientific society meeting. These situations have exposed our students to experiences which would have been otherwise impossible.

Short and long term criteria have been developed for evaluating the impact of the program in increasing the number of students entering upper level science programs.

SESSION V.

Learning Mathematical and Statistical Concepts through a Programming Language

Murray Eisenberg
Department of Mathematics and Statistics
University of Massachusetts
Amherst, MA

When computers are used in science instruction, the emphasis is typically upon interacting with the program - whether running computer tutorials or examining output from simulations and other routines. This paper considers, by way of contrast, the activity of writing programs itself as an aid to learning mathematical concepts. The claim is that many abstract principles, often learned imperfectly when students only work out particular instances of them, can be more perfectly learned when students must express them unambiguously in a language that a computer can execute; the claim is, further, that the programming language APL is an especially suitable medium for doing so. This claim is illustrated by several student programming projects used in linear algebra, statistics, and differential equations courses for science majors at the University of Massachusetts. These projects have been developed as part of curricular improvement made possible by an NSF-ISEP grant.

SESSION VII.

A Solar Laboratory—A Key to Comprehension

Fred W. Emshousen
Department of Mechanical Engineering Technology
Purdue University
West Lafayette, IN

Fundamentals of solar energy systems have been integrated into the Mechanical Engineering Technology curriculum. With the assistance of a NSF-ISEP grant, many different types of solar collectors have been fabricated, instrumented, and installed in the Energy Applications Laboratory. The laboratory activities permit students to compare performance of various types of solar collectors as well as demonstrate the fundamental concepts of collecting, storing, and using solar energy in domestic applications. This effort has been very successful in aiding non-technical as well as technical students in learning the basic concepts and technology of using solar energy.

The presentation is a summary of the author's experience in developing the solar laboratory facility. The focus will be on how to design and construct a solar laboratory facility which will be an effective teaching tool. This will include an identification of needed equipment and instrumentation as well as techniques for minimizing cost and complexity of the facility.

SESSION IV.

Human Anatomy Course Adaptations to Meet Emerging Student Needs

Mary Jo Fourier
Department of Biological Sciences
Johnson County Community College
Overland Park, KS

The Human Anatomy course at Johnson County Community College had seen an increasingly diversified and older student population develop over the ten years of the college's existence. The traditional way of offering the course no longer met the needs of the largest client group, the older adult learner preparing for a health care related vocation.

A National Science Foundation LOCI grant provided funds to revise the course to provide a more flexible format based on a three part improvement program. This included 1) the studio production of a telecable course; 2) the preparation of criterion-referenced tests for use in a new mastery learning format; and 3) initiation of a cognitive style assessment program.

These techniques have provided a revised Human Anatomy course with components suitable to the adult learner as well as a model for course revision applicable to other community college courses. This presentation will summarize each of the three components and will reflect on the experiences encountered in the first offering of the revised course as a telecourse.

SESSION VI.

Videotapes for Environmental Geology

Glenn W. Frank
Department of Geology
Kent State University
Kent, OH

The world faces a variety of environmental problems. Some are natural, and some are induced by man. Many of the latter problems promote emotional reactions, and we often "tune out" individuals with "low credibility", particularly when we question the data presented.

There seem to be at least three major areas to deal with as we examine environmental problems induced by man. These are (1) data collection and information dissemination, (2) technical and mechanical considerations, and (3) political and/or industrial decision making. These three must interface in order to successfully address environmental issues. It is felt that recognition and understanding of both one and two above will promote better perceptions and more considered decision making.

A National Science Foundation grant for Local Course Improvement (LOCI) has permitted production of four, thirty-minute videotapes. The objective is to allow students in Environmental Geology courses to observe the technical and mechanical processes, concerns, limitations and costs involved in four selected sites:

1. water treatment plant
2. sewage treatment plant
3. coal strip mine and reclamation
4. oil well drilling site

The aim is to develop a more informed electorate which shall be in a position to make wise environmental decisions affecting our future way of life.

SESSION III.

Video Enhancement of Microcomputers in Science Education

Roger H. Geeslin
Department of Mathematics
University of Louisville
Louisville, KY

There are many ways that video technology can enhance the use of microcomputers in science education. They range from the simple addition of an extra video monitor for a group viewing to the interactive control of a video disk system by a microcomputer.

This presentation will discuss this broad range of applications. The major focus will be on the use of video tape presentations as a means of disseminating computer generated material to individuals, small groups, or classes. Demonstration of sample video tape applications in the areas of computer based drill and practice, simulations, interactive testing, and the presentation of new instructional material will be given as time permits.

SESSION V.

The Role of the Soil Mechanics Laboratory in Undergraduate Civil Engineering Curricula

Vito A. Guido
Department of Civil Engineering
The Cooper Union School of Engineering
New York, NY

In the last 15 to 20 years the branch of Civil Engineering known as Geotechnical Engineering has made rapid advancements. Most of these advancements can be attributed to much improved laboratory testing techniques of soil. Prior to about 1940, most foundation problems were handled by engineers having little, if any, technical knowledge of soil, and designs were based solely on experience and/or rules of thumb. Consequently, the foundations were over-designed and uneconomical. Today, most major Civil Engineering consulting firms employ some personnel, if not an entire division, with Geotechnical Engineering expertise. This is especially true with those consulting firms dealing in offshore drilling, land reclamation, tunneling, port facilities, highway construction, etc. In addition, many smaller consultants expect their Civil Engineers to have some background with the basic properties of soils. Therefore, all Civil Engineering students should have a thorough working knowledge of the mechanics of soils which can only be achieved with "hands-on" laboratory experience in a basic undergraduate Soil Mechanics Laboratory. The laboratory experiments performed should range from the very fundamental indexing tests of soil to more advanced testing, such as consolidation and strength tests. As one undergraduate student commented to me this past semester, "...the Soils Mechanics Laboratory was not just a complement to the lecture material but an essential tool for completely understanding the lecture material...".

SESSION IV.

Technology Advances and the Undergraduate Laboratory

Brian Huggins and T.L. Stewart
Department of Electrical Engineering and Electrical Engineering Technology
Bradley University
Peoria, IL

Innovations in solid-state fabrication technology and device physics have been a major driving force in the electronics revolution that has been underway the past 30 years. Solid-state devices of increased capability and decreased cost are being designed and fabricated in many research labs and companies. These devices range from computers on a chip to GaAs FET's that operate at frequencies in excess of 40 GHz. A real educational need at present is to incorporate these advances into university science, engineering, and technology curricula. The Department of Electrical Engineering and Electrical Engineering Technology at Bradley University is accomplishing this by using equipment acquired under an NSF-ISEP grant.

In electronics, the complexity of experiments in undergraduate engineering and technology programs has increased dramatically with the ready availability of sophisticated digital system components, including microprocessors. Support of these experiments requires new types of instrumentation for measurement and trouble shooting. A versatile and almost indispensible instrument is the logic analyzer, and a Tektronix 7D02 logic/microprocessor analyzer was recently acquired under an ISEP grant. The capabilities of this unit and its application in our laboratories will be presented.

A microwave sweep oscillator system was also obtained with the help of NSF-ISEP grant funds. This is a very versatile instrument which plays a crucial role in testing microwave system and, since its acquisition, has enabled students to undertake interesting senior projects in the microwave area. These and future projects as well as the instrument's operation will be discussed in the presentation.

SESSION IV.

Case Studies of Academic Computing at Minority Institutions

Beverly Hunter
Human Resource Research Organization
Alexandria, VA

Case studies describe academic computing at four minority institutions:

- Bennett College, Greensboro, North Carolina
- Community College of Baltimore, Maryland
- Florida A&M University, Florida
- Jackson State University, Mississippi

The case studies are designed to assist administrators, staff and faculty at minority institutions in identifying academic computing needs; establishing educational goals for computing; organizing and staffing computer centers; extending computer applications in specific disciplines and courses; raising the level of computer literacy on campus; improving computer science curricula; preparing five-year plans for academic computing; and making personal contacts with experts at the exemplary institutions.

Factors influencing successful academic computing are found to include support of top administration; dedicated efforts of one or more key persons; use of federal grant support; innovative approaches to acquiring adequate staff and faculty.

SESSION VI.

Laboratory Skill Development for Preservice Science Teachers

Robert K. James
Department of Curriculum and Instruction
Kansas State University
Manhattan, KS

A review of the work of the Laboratory Skills Development Project will be presented. Three research studies involving practicing science teachers, science educators, and preservice science teachers have been conducted to determine need and appropriateness of the skills thought to be needed in the conduct of science laboratory learning experiences. The National Science Foundation, through its Local Course Improvement Project, has funded the development of thirty self-instructional modules in laboratory skill development. Those materials have been tested and edited and are now in final form.

A rationale for providing laboratory teaching skills will be reviewed. Research results will be presented. Particular attention will be given to the development and use of the self-instructional materials. Future directions will be described.

SESSION VI.

Computer Simulations and Dialogs in Physics at UDC

Daryao S. Khatri and Edward H. Rogers, Jr.
Department of Physics
University of District of Columbia/MVSC
Washington, DC

The University of the District of Columbia is a co-educational predominantly Black institution located in an urban setting. The CAUSE project was funded by NSF in 1978 for a period of three years. The project deals mainly with simulations and development of dialogs using graphics capabilities of the 4010-series Tektronix terminals and their TCS graphics package. The main frame used for the project is DEC2060 computer system. The National Science Foundation chose our project for presentation at the 1980 CAUSE project directors' meeting which was held at Norfolk, Virginia. During the course of the project we have developed very useful FORTRAN subroutines for drawing English alphabets, numerals, Greek alphabets, and mathematical symbols. We have divided our project in three parts, namely simulations, dialogs, and laboratory exercises. We have done extensive work in the first two categories. Selected examples from both categories will be presented at the conference. We would like to emphasize that our work is done in FORTRAN IV and is easily transportable for use at other educational institutions. Our work is different from the work of some other groups as their work is done in MACRO and is not transportable.

SESSION I.

Computer Literacy - A Working Model

Fred Kollett
Computer Literacy Project
Wheaton College
Norton, MA

A successful computer literacy project can be assured by offering abundant faculty development opportunities in each of the areas of instructional computing, statistical packages, a computer-aided instruction language, text editing and formatting, a strong query language, and a subroutine package which will allow facile development of graphics software. In addition, students must have access to several entry-level courses which use the computer, a serious, disciplined programming course, and, of course, ready access to terminals.

An established program of this type is the perfect base from which to launch a "computer proficiency" program within the liberal arts. The objective of this program would be an understanding of the roles of structured programming, data and file structures, operating systems, compilers, machine language, assembly language, and higher level languages in computer applications.

The talk will provide details of success of this approach at Wheaton College. Wheaton's Computer Literacy Project was sponsored by the Comprehensive Assistance to Undergraduate Science Education Program of the NSF.

SESSION I.

Piaget-based Integrated Math and Science Program

George Kolodiy
Department of Natural Science and Mathematics
Bloomfield College
Bloomfield, NJ

The mathematical aptitude of college freshmen at Bloomfield College has been found to be severely lacking in basic mathematical reasoning. Although many students may have become proficient in mathematical manipulation, they have very little command of fundamental concepts and very little reasoning ability. Students have shown a severe lack of understanding of fractions, decimals, and reading scales.

It is our belief that such a situation has occurred because students learn mathematics devoid of reality and physical manipulation. A general education course of study is described in which mathematics is integrated with science in a single course thus motivating the mathematics and giving meaning to manipulations and symbols. The structure of the course is based on the learning cycle approach which emphasizes physical experience and peer interaction.

A controlled experiment comparing parallel control and experimental groups has shown that this type of approach yields significant improvement in basic mathematical reasoning.

SESSION VII.

Video Modules with Computer Graphics for Precalculus

Edward M. Landesman
Department of Mathematics
University of California at Santa Cruz
Santa Cruz, CA

During a five-year period, the University of California, Santa Cruz supported the preparation of eighty-four video modules as supplements to traditional, large-group lectures in calculus and precalculus. Although these modules were simply produced, using two black & white cameras and minimal editing, student response has been positive: each quarter, these tapes receive hundreds of replays by individual students.

This work provided the experience for a new series of nine video modules on key concepts in precalculus. These tapes have been produced with support from NSF's Local Course Improvement program. More elaborate production techniques were used to add interest and clarity to the presentations, and to encourage students to develop confidence in their mathematical skills. The tapes were produced in color, using studio settings and dialogs with "typical" students of precalculus. Computer-generated graphics also were used, with animation techniques used to demonstrate concepts and to hold attention.

These recently produced video recordings are expected to be even more effective than the earlier series of black & white recordings. While the new modules are quite different in appearance from their predecessors, they are very much the same in that they have been designed for individual student uses as supplements to traditional instruction.

Both the old and new series of video modules present direct teaching, with no opportunities for interactive learning. Current work, now in progress, will develop techniques to combine video recordings and microcomputers, providing both observational and interactive learning opportunities. This work, which is being supported by NSF's Development in Science Education program, makes use of devices that interface video-tape players and microcomputers, and draws on insights from cognitive psychology to help reduce the anxieties that often are experienced by students of mathematics.

SESSION VIII.

Interdisciplinarity - A Means for Revitalization of an Environmental Studies Program

Charles W. Lee
Department of Chemistry, Physics and Environmental Science
William Paterson College of New Jersey
Wayne, NJ

As the environmental field is multidisciplinary in nature, a clear understanding of how individual disciplines are interrelated is prerequisite to the comprehension of how and why problems can occur before one can propose solutions to them. For the student of the environment, interdisciplinarity is then the interrelating of many disciplines toward the definition of the environment and/or the resolution of a common problem of environmental concern.

The revitalization of a moribund environmental studies program at William Paterson College was initiated (via a NSF/CAUSE grant SER #79-07930) on the premise that a sound curriculum had to be built around such an interdisciplinary approach.

This presentation explores the pedagogical methods of retraining faculty; the administrative requirements to affect such changes with minimal agitation; the selling of the program to incoming students and the advisement problems of a heterogeneous group of students already majoring in the field.

Pertinent new and revised courses will be used as examples to illustrate the complexities, advantages and disadvantages of interdisciplinarity.

Finally, some thought will be shared as to why such an approach has a successful future in higher education.

SESSION V.

Development of a Science and Technology Course for Undergraduate Nonscience Majors

Ann T. Lemley
Department of Design and Environmental Analysis
Cornell University
Ithaca, NY

A 1980 report to the President on science and engineering education predicted a trend toward scientific and technological illiteracy in the population, and a need for new curricula for nonscience students. The need for this type of course was established several years ago in the College of Human Ecology at Cornell, and a National Science Foundation Local Course Improvement Grant was applied for and received. The course, "Science, Technology and Human Needs" was first taught during the Spring, 1981, term and extensive evaluation was done. Contemporary problems or advances in technology such as energy, air and water pollution, toxic wastes, and risks and regulations are some of the topics which were covered. Scientific principles were used as necessary to discuss these topics. The curriculum, readings, and type of student taking the course will be presented along with evaluation results.

SESSION II.

Computer Assisted Instruction in Earth Science

Henry Lepp
Department of Geology
Macalester College
St. Paul, MN

Computer self-tests have been available as study aids for students in introductory geology and oceanography courses at Macalester College since 1977. With support from the LOCI program of NSF, the original self-tests are being edited and expanded, and a new series of computer lessons are being developed. Students now have access to three types of computer learning aids, namely: (1) multiple choice self-tests, (2) free form tests written in PILOT with instructor feedback, and (3) drills where the student is asked to repeat wrong answers with increasingly broader hints from the program author.

Some of the computer programs are housed in the college's PDP-11 system and may be accessed at any of some 30 terminals. Others are available on APPLE II's in the geology department.

Examples of the three types of programs will be shown. Of the 82 students using the programs during the 1981 spring term, 52 percent tried them all and 78 percent rated the tests and lessons very useful as study aids. Further statistics on student use and response will be reported for the fall term of 1981.

SESSION III.

Use of Modular Units in Instrumental Analysis Laboratory

Chia-yu Li
Department of Chemistry
East Carolina University
Greenville, NC

This work describes how we improved some of the spectroscopy and electrochemistry experiments with instrumentation modules in the Instrumental Analysis lab for senior chemistry students. In a conventional lab, students are normally given hands-on experience in the use of UV/Visible spectrophotometers and polarographs among other instruments. However, the emphasis is often placed on learning the "push button" routine rather than understanding basic instrument design. Since it is impractical to disassemble a sealed equipment to show its interior construction, we took the alternate approach of asking students to build instruments from low cost modules. These include power supplies, light sources, monochromators, photomultipliers, and various forms of operational amplifiers and electronic devices. Students were required to construct a single-beam spectrophotometer, a DC and cyclic scanning polarograph, and other electroanalytical apparatus. We found that through the use of these modules students can get a more in-depth understanding of how these instruments actually work. The instrument building experiments are not intended to replace traditional experiments using commercially available equipment but rather to complement them. This work was supported by a NSF-ISEP grant (SER-7913320).

SESSION VIII.

Using C.A.I. in Environmental Biology

David McCalley
Department of Biology
University of Northern Iowa
Cedar Falls, IA

Several computer assisted learning packages are used in an environmental biology course. They include GRAZE, POLUT, POP and USPOP. These have provided the dynamic quality to learning basic ecological ideas during the inclement winter months of the upper Midwest. The course includes both biology majors and students electing it for general education purposes. Stress will be on how the C.A.I. materials are incorporated into the course as a whole.

SESSION IV.

Improving Education to Keep Up with Modern Technology

Suzan McCoury
Department of Science-General Education
Mayland Technical College
Spruce Pine, NC

My proposal was initiated to provide monies to fund equipment lacking from our college science labs. Small community colleges often lack sufficient funds to provide extras needed by new programs. Student enrollment often fluctuates and may not be high enough to justify funding of high cost equipment under school policies. However, science courses cannot be fully taught even to one person without proper equipment. Many industries and laboratories are now using computers and computer applications such as digital analytical balances and more sophisticated microscopes.

Our community college needed more and better equipment to keep up with industry and to provide the education necessary for graduates to be prepared for a four-year college or a better job.

SESSION I.

Simulating the Effects of Economic Policy Changes: Classroom Implementation of a Macro-microeconomic Policy Analysis Model

Edward M. McNertney and C. Richard Waits
Department of Economics
Texas Christian University
Fort Worth, TX

A hypothetical model of the economy which integrates macroeconomic and microeconomic analysis has been developed by the authors for use in the classroom. The students are allowed to make macroeconomic policy decisions and then examine the effect of these policies on income distribution, factor prices by sector, and sectoral employment. At the same time, the students can make microeconomic decisions regarding individual employment, investment, and household spending and will experience the effect of these decisions on the aggregate price and employment levels, national income, and income distribution.

In this session, the authors propose to illustrate the usage of this model in a Principles of Economics course and to discuss its impact on student learning. Slides and copied examples of student sessions and simulation results will be utilized to aid in attaining the objectives of the session.

SESSION III.

Weber State College Field Based Geography Program

Don R. Murphy
Department of Geology/Geography
Weber State College
Ogden, UT

Outstanding examples of geologic, geographic, vegetational, pedologic, archaeologic, historical, and various other natural phenomena are available for "hands on" examination within the state of Utah. At Weber State College four geography field based short courses have been structured and developed to allow the student this first hand field experience and to demonstrate to those students entering the teaching profession the value of a field based learning program. Each of the four programs concentrate upon a particular locality within the Canyon Lands subprovince, an environmentally critical area which is well suited for a field based program. These four locations include the Arches-Canyonlands National Parks area, the Natural Bridges National Monument area, the Capitol Reef National Park area, and the Escalante River Canyons area. A manual (text) has been written for each of the four regions with each manual concentrating upon the particular region's academic wealth. These volumes vary in length from 35 to 80 pages and help to guide the student within the learning process. The development of this program, sponsored by an NSF LOCI grant, has allowed Weber State College to academically upgrade its field based program and provide a more meaningful learning experience for its student participants.

SESSION VI.

The Norrie Point Project

Henry M. Muschlo
Department of Biological Sciences
Dutchess Community College
Poughkeepsie, NY

The Norrie Point Project will provide a completely renovated permanent building site on the Hudson River, with teaching and research facilities, laboratories, a museum facility and conference center for use by the Dutchess Community College students, faculty and administration and in cooperative efforts with the New Yoirk State Parks Department. The facility is located in the Norrie State Park, Staatsburg, New York, approximately 15 miles north of Poughkeepsie and 90 miles north of New York City. Educational facilities for the College's Natural Resource Conservation Program will be permanently housed at this site. Faculty will develop modules in various biological areas at the site including a nature-trail for use by students and the public. A museum housing exhibits of flora and fauna of the Mid-Hudson area and Dutchess County, New York, will service the needs of students and the public. Educational and research programs in biological and physical sciences, ecological and aquatic studies and outdoor living experiences will be offered to primary, secondary and area college students as well as to disadvantaged and physical/multiple handicapped individuals. Conference facilities will be offered to governmental agencies, and industrial and educational groups.

Although the College has received several grants in excess of $400,000 to fund this project, approximately $318,000 was received from an NSF-CAUSE Grant (1979-82). This lecture/slide presentation will depict the various phases in the development of the Norrie Point Project.

SESSION V.

Benefits for All in a Chemistry Laboratory Safety Course

L. Jewel Nicholls
Department of Chemistry
University of Illinois, Chicago
Chicago, IL

Training of chemists in the techniques of safe operations is becoming more important. Thus at the undergraduate level a course in chemical laboratory safety can fill a need and contribute to the effectiveness of an education in chemistry or related sciences. At UIC we have developed such a course for upper level undergraduates which has proven beneficial to the students who took it, to others of the student body who see the resulting emphasis on safety, and to the sponsoring department which gained better communications with safety organizations on campus, as well as a collection of audiovisuals and books. In addition, faculty members are more aware of safety considerations than before. Students with a background of two years of chemistry (and some instruction in safety) are able to look at safety problems with some theoretical and practical background. Texts, course outlines, supplemental materials, and audiovisuals will be discussed. This work is supported by the NSF by a LOCI grant.

SESSION VIII.

Training in Policy Analysis for Undergraduates

B. Pakizegi
Department of Psychology
William Paterson College of New Jersey
Wayne, NJ

As the need for making scientific knowledge relevant to on-going life has become an accepted aspect of many college curricula, courses and programs have been developed to respond to this need. Policy analysis has been one such area. As governments on various levels have become involved with the use, dissemination and regulation of scientific knowledge, institutes such as Eagleton arose to train graduate students. The involvement of undergraduates in the study of policy processes has been even more recent. Only a few colleges across the country offer this area of study to their undergraduates.

William Paterson College of New Jersey offers one such program. In 1979, Faculty from the Psychology, Political Science, Sociology and Economics Departments collaborated in developing an Honors program in Policy Analysis, in which the students could study the application and relevance of the various Social Sciences to policy formulation, implementation and evaluation. An NSF/LOCI grant has helped in this development.

The program involves a core curriculum composed of four courses: "Basic Issues and Cases in Policy Analysis," "Policy Formulation and Implementation," "Evaluation," and "Internship and Seminar." The program has been in existence for only one year and so far, only the first course has been offered. Our evaluation of events so far points to issues and areas that need further thought before we embark on the second year of the Program. We are grappling with questions such as how to integrate our team taught efforts in the first course, what reading material is appropriate and of interest to undergraduates, what area to focus on (e.g. international vs. local), and how to balance the need for student enrollment and maintenance of Honors Program standards as funds become more scarce. We will be trying various approaches to questions such as these in the upcoming year, and we anticipate that we will have much to learn as we progress.

SESSION III.

CAI in Environmental Studies

Dennis M. Richter
Department of Geography
University of Wisconsin - Whitewater
Whitewater, WI

Computer applications in physical and environmental geography can be integrated into freshman level college courses with a minimum of programming skills required of the student. Interactive terminal usage to allow the student to respond to background information leads to a better understanding of lecture material, summarizes and clarifies important concepts from laboratory sessions, and lends itself to computer generated review quizzes.

Expansion to programs for weather and climate, air pollution, acid precipitation, water resources, and land use/resource evaluation by microcomputer is easily accomplished using APPLE II hardware. Response to use of the micro for select laboratory sessions in two geography classes designed to satisfy University general studies requirements has been excellent. Mapping of various phenomena allows generation of questions and pictorial responses to the student with follow-up elaboration. The subtle learning approach using the micro as a teaching tool and a partial entertainment vehicle appears to have a significant effect on comprehension and retention of materials.

Microcomputer Software for Use in the Science and Mathematics Curriculum

Theron Rockhill
Microcomputer Project
SUNY College at Brockport
Brockport, NY

The SUNY Brockport Science and Mathematics Microcomputer (SAMM) Project is designed to develop and implement instructional uses of microcomputers in undergraduate science and mathematics courses. With support from the National Science Foundation CAUSE Program, the SAMM Project has: (1) conducted workshops for science faculty on instructional uses of computers, instructional development techniques and computer programming; (2) supported faculty-student (author-programmer) teams to develop instructional modules for using microcomputers in teaching science and mathematics and; (3) implemented a wide range of instructional uses of microcomputers including drill and practice, tutorial, problem solving, modeling and experiment simulation.

This session will be a report on the science and mathematics modules which are currently available for use by students. Each instructional module includes a documented BASIC program written for the APPLE II Plus microcomputer and a written user's guide.

SESSION V.

EFIELD - An Example of Computer Tutorial at UDC

Edward H. Rogers, Jr. and Daryao Khatri
Department of Physics
University of District of Columbia/MVSC
Washington, DC

The computer tutorial program EFIELD was conceived as a supplement to the treatment of the electrical field concept in the introductory non-calculus College Physics course. Most texts at this level treat the electric field concept very lightly, often ignoring an explanation of the illustrations of the electric lines of force. This tutorial begins with the concept of a force field in general and then specializes to the electric field in particular. Examples of the electric field of a dipole, two positive charges, and three positive charges are given. Rules governing the interpretation of electric field patterns are emphasized. Heavy use is made of the graphics capabilities of our Tektronix 4010-series terminals in showing the construction of electric field patterns. The user is asked several questions during the dialog and answers are recorded for later analysis. The student is able to proceed through the material at his or her own pace at a time which is convenient to the student. The program is written in FORTRAN utilizing the Tektronix TCS software package for control of the terminals' graphic features.

SESSION I.

The Role of Television and Computer in Undergraduate Science Education

Buddhadev Sen
Department of Chemistry
Louisiana State University
Baton Rouge, LA

The paper briefly describes the beginning of the American educational system and its rapid transition during the post-second World War period. The effect of massive enrollment on academic processes is discussed. The appropriate and desirable role of modern technology in the educational process is discussed.

Results of exploratory use of television in laboratory courses in the Department of Chemistry, Louisiana State University are presented. These results have guided formulation of a philosophy regarding the use of television in undergraduate science education.

Attempts are now being made to implement a comprehensive computer assisted learning program coupled with a fairly advanced instructional television program. The author's experiences are discussed.

SESSION II.

Implementation of Microprocessor Based Instrumentation in the Undergraduate Chemistry Laboratory

Michael D. Seymour
Department of Chemistry
Hope College
Holland, MI

The use of microprocessor based instrumentation offers several definite advantages in an undergraduate chemistry program: 1) it can directly present analytical results so that a student may readily assess whether or not an experiment is working correctly, 2) less time is spent on the set-up and adjustment procedures, such that more time can be spent collecting useful data, 3) instrument interlocks allow for safe operation, 4) students are better prepared to cope with the type of instrumentation they will likely encounter upon entering a chemical position after graduation.

The development of new courses, the improvement of old courses, or the eventual replacement of aging instrumentation all provide opportunities for the consideration of microprocessor based instrumentation. These sophisticated instruments cannot, however, be viewed as the sole answer to the betterment of student training. Rather, they must be used as part of an overall program in which they amplify the basic concepts and principles of the methods being studied.

SESSION VIII.

Preparing Computer Aided Instruction Lessons by Committee

Dorothy Sinise
Department of Physical Science
Amarillo College
Amarillo, TX

The Association for Educational Data Systems has proposed that CAI lessons should be prepared by a committee consisting of an educational specialist, a computer expert, a programmer and one or more subject matter specialists. This committee system is exactly the one adopted by the physical science department of Amarillo College for its NSF-CAUSE grant. This system has worked very well, with the result that lessons in chemistry are being prepared without chemistry faculty being required to do their own programming, testing and evaluation. It is a system that should be copied by other colleges.

SESSION II.

Using C.A.I. to Present a Grassland Ecological Simulation

Daryl D. Smith
Department of Biology
University of Northern Iowa
Cedar Falls, IA

A tutorial lesson has been developed based on an existing ecological simulation program. The student is required to select initial populations of predators in order to keep the grassland ecosystem in balance over a 15 year period. The resulting population changes are presented graphically. The number of cattle living on the grassland are set at different values by the program and this affects the balance between the predators and the rodents and grasshoppers. The structure of the C.A.I. lesson, incorporating both tutorial and simulation aspects, will be described in some detail.

SESSION IV.

Science for the Undergraduate Non-scientist

Richard Stebbins
Department of Chemistry
Bethany College
Bethany, WV

Upon evaluation of our curriculum, the need for Bethany College to strengthen its offerings in the area of general science became apparent. The development of a 4-hour interdisciplinary lecture-laboratory course entitled "Intelligent Life in the Universe" attempted to address this need. The course was designed specifically to meet the needs of upperclass non-science majors seeking to fulfill the general science education requirements of the College.

The major course objective was to introduce students to the currently important scientific ideas concerning conditions necessary for the origin of life on Earth, and the possibility of extra-terrestrial intelligence. Accomplishment of this objective required a conceptual introduction to the following: basic astronomy and cosmology, basic structure in nature, preparation of the Earth for life, pre-biotic evolution and the nature of intelligence.

Development of a laboratory component sets this course apart from similar courses at other institutions. The laboratory experience is central to the teaching of thought processes associated with science and is an integral part of the course.

The course was developed in the summer of 1980 and first presented during the spring semester, 1981. It was evaluated and revised in June of 1981 and offered again during the fall of 1981. A summative evaluation of student attitudinal change was concluded in January 1982.

SESSION VI.

Consulting Firm Scenarios for Mathematical Modeling

George E. Strecker
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Kansas State University
Manhattan, KS

Since the fall of 1980, a course in mathematical modeling for agricultural economics students has been developed and taught at Kansas State University. An approach used in the course has been to simulate the situation of an economics consulting firm which has recently hired the members of the class. Various realistic problems are presented as if proposed by a client. Members of the class then work toward: (1) stripping the problem of non-mathematical aspects, (2) making reasonable simplifying assumptions, (3) acquiring any new mathematical background necessary, (4) solving the simplified mathematical problem, and (5) writing a report that can be used to submit to the client. Various aspects of the strengths and weaknesses of this approach to learning mathematical modeling will be discussed.

SESSION VII.

TESTOR: An Instructional Management and Student Evaluation Tool for Programs of Individualized Instruction

Gerald Summers
Division of Biological Sciences
University of Missouri-Columbia
Columbia, MO

A computer-testing system (TESTOR) is presented as one component of a program of individualized instruction in a general biology course for university students. Students receive learning objectives for modularized exercises and are examined by computer-generated quizzes upon completion of each module. Students are permitted to repeat quizzes as necessary to achieve mastery. Mastery is required for credit but is not essential for advancement to subsequent modules.

Student evaluation is based on computer-generated quizzes (10) and comprehensive exams (3). The comprehensive exams cover three or four modules and are given in mass testing. Students are not permitted to repeat comprehensive exams. TESTOR permits examination of relationships between individual performance on modular quizzes (e.g., single score, summed scores, frequency of testing) and overall achievement on comprehensive exams. Such information is useful in curriculum evaluation and research into the relationships between individual differences and mastery learning strategies. In addition, TESTOR reduces the amount of faculty time devoted to clerical chores associated with record-keeping in large classes.

SESSION V.

Political Science Instruction and the PLATO Medium

Richard T. Sylves
Department of Political Science
University of Delaware
Newark, DE

Political scientists responsible for teaching public policy and public administration courses are faced with a challenge. How can advanced features of computer technology be exploited for student experimentation in their courses? This NSF funded project addressed this question in development of a collection of PLATO (CDC) simulations and tutorials which enable students to make generalizations, to test theories, and to perfect models of the public policy process.

In one simulation students assume the role of a House committee chairman responsible for managing a higher education assistance bill through the U.S. Congress. A second challenges students to formulate, and defend against cuts, a budget for their state agency. In another highly visual exercise, students play environmental grants administrators confronted with ecological concerns, political pressures, and spending constraints. The fourth exercise asks students to carry out a legislative redistricting, first to gerrymander the state to favor their political party, then to favor the opposing party, and finally to be judiciously fair to each political party.

A portable terminal phone-linked to my home university will be used to demonstrate this innovative use of computer technology for political science education.

SESSION III.

Introducing the Micro Computer into the Chemistry Laboratory

Morris D. Taylor
Department of Chemistry
Eastern Kentucky University
Richmond, KY

The microcomputer has become an economical tool for use in the chemistry laboratory. The technological developments in the microcomputer allow a wide range of capabilities, especially with computer graphics, which make it invaluable for some tasks in the laboratory. The Department of Chemistry has acquired four Apple II microcomputers on an ISEP - NSF grant and two more on the departmental budget.

The members of the Department are actively developing software to be used in the freshman chemistry laboratory. The primary purpose of the software is twofold. First, software has been developed to simulate experiments that are difficult to perform or are difficult to get good results, such as Boyle's law, empirical formula, and calorimetry. Second, software has been developed to interface the Apple to an instrument, or thermister, and to collect temperature data. Then this data can be analyzed, using the computing capabilities. Other programs are under development.

The project is directed toward the evaluation of this software in the laboratory to assess student attitudes toward the computer and to assess the effectiveness of the software as a teaching device.

SESSION VIII.

Coastal-Environmental Studies

Elaine Wallace
Department of Coastal-Environmental Studies
Wayne County Community College
Detroit, MI

One of the objectives of the science curriculum at Wayne County Community College is to provide two-year college students with skills and training that will make them employable in science related fields. The Coastal-Environmental Studies Project (developed with funding from the National Science Foundation) is designed to encourage students to pursue science careers and develop skills that will prepare them for meaningful employment.

The Coastal-Environmental Studies Project (CESP) commenced on July 1, 1979. Consultants from the following agencies and institutions participated in developing a curriculum which prepares students for existing jobs: Eastern Michigan University, Environmental Research Institute of Michigan, Michigan Department of Nature Resources, Michigan Sea Grant Program, University of Michigan, University of Rhode Island, and Wayne State University.

The Coastal-Environmental curriculum includes thirteen new science courses. The following topics/items are included in the curriculum: LANDSAT - Remote Sensing, Coastal Laws, Land Use Policy (zoning) - in relation to shorelines and environment, Field Geology (coastal and depositional and erosional processes, soil testing, wet land ecology), Aerial Photo and Topographic Map Reading, Laboratory Technology, Technical Writing and Library Work, Elementary Computer and Statistics, Field Course on the Use of Instruments, Limnology, Water Quality labs, and Independent Study Project.

SESSION I.

Using C.A.I. to Introduce a Dichotomous Classification System and Identification Key

Robert T. Ward
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University of Northern Iowa
Cedar Falls, IA

A C.A.I. lesson has been developed for an activity based introductory science course for non-science majors. The dialogue leads the student through the development of a dichotomous classification system for geometrical shapes and its use as an identification key. Extensive use is made of the graphic capabilities of the system. The lesson prepares students for the later use of a tree leaf key in the laboratory. Aspects of the lesson's development process and evaluation will also be discussed.

SESSION IV.

Development of Science Learning Modules Using C.A.I. and the Polaroid Interactive Lecture System

Glenn Y. Yoshida
Life Science Department
Los Angeles Southwest College
Los Angeles, CA

Los Angeles Southwest College is implementing a two-year project designed for students to correct deficiencies in their science background. Project activities include the development of learning modules using computer-assisted instruction (CAI) and the use of the Polaroid Interactive Lecture System. Both instructional modes are self-paced, individualized, and provide immediate feedback to students. A series of color slides along with the audiotapes have been developed and will be utilized in conjunction with the instructional material on the computer screen. Faculty-developed modules include "Pollination and Fertilization," "Variation and Selection," "Plant Communities of So. California," "Plant Ecology," and "Biological Terminology." A wide variety of lecture tapes have also been prepared on the Polaroid Interactive Lecture System. With this system, the student is able to run an audiotape which plays back the instructor's voice while the unit concurrently writes an almost exact replication of the instructor's notes or diagrams on a paper format. The faculty will explore, implement, and evaluate these techniques in order to improve the quality of preparation of students for graduation and careers in science.

SESSION VII.

Undergraduate Laboratory in Sensory Physiology and Perception

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Parmly Hearing Institute
Loyola University
Chicago, IL

An undergraduate laboratory for courses in hearing, vision, and selected topics in psychobiology has been built at Loyola University with support from an ISEP grant and from the Parmly Hearing Institute. The laboratory has four experimental stations, a general purpose work bench, an optical bench, and a physiological work space. Each station contains an Apple II microcomputer with 48k of memory, bi-directional digital I/O, A/D and D/A interfaces, and a slide projector/tape-recorder system. Three stations are also equipped with audio equipment and biological amplifiers and filters. A printer is present in a fourth station for hard-copying results and programs. The laboratory courses are designed such that psychology and biology undergraduates may learn about experimentation in hearing, vision, and psychobiology without having to program the computers. The courses are offered in such a way that the students may work at their own pace on the course material. Examples of the type of experiments to be conducted in the laboratory will be demonstrated.

SESSION VI.